GPM Applications and Outreach: Status Update

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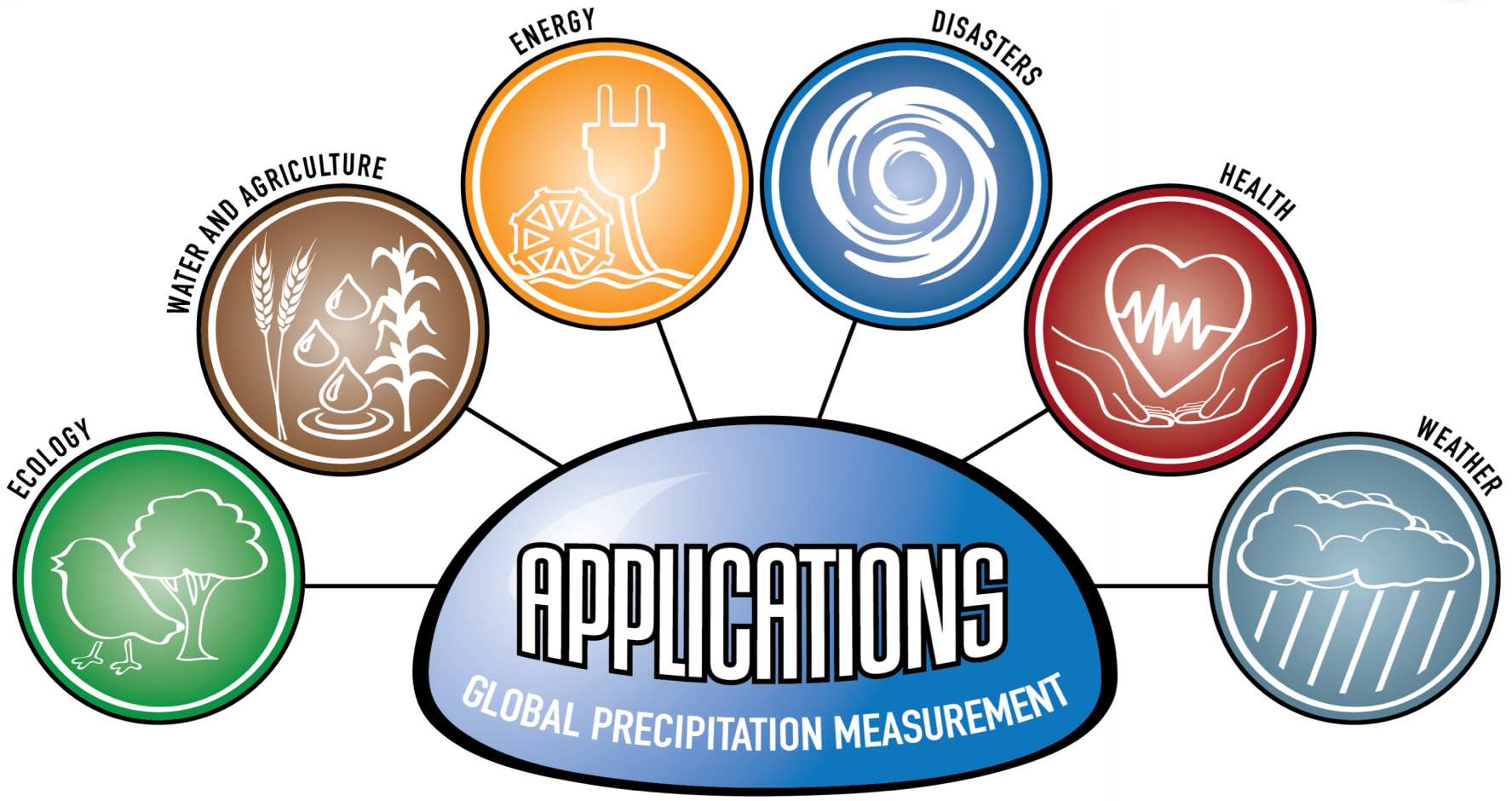
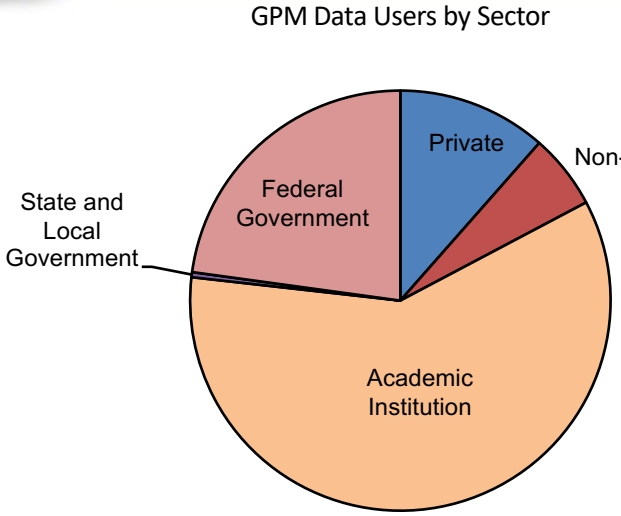
Overview of Applications

1. **Expand the portfolio** of GPM and TRMM applications and highlighting examples from thematically-focused communities
   - Database of unique users
   - One pagers and videos outlining GPM applications
   - Case studies to track data through the decision making pipeline
2. **Engage users communities** in trainings, workshops, and stakeholder interactions
   - Vector and Water-borne Disease Workshop
   - Web-based Training sessions accompanying the workshop
   - Engagement with “middle” organizations to bring GPM data into decision making portals (Pacific Disaster Center, US Army Geospatial Center, World Resources Institute, etc.)
3. **Improve data access** and visualization of core GPM products for rapid ingestion and analysis for use by the community
   - Continued development of new visualization and data access capabilities

Applications Areas



GPM Applications Portfolio

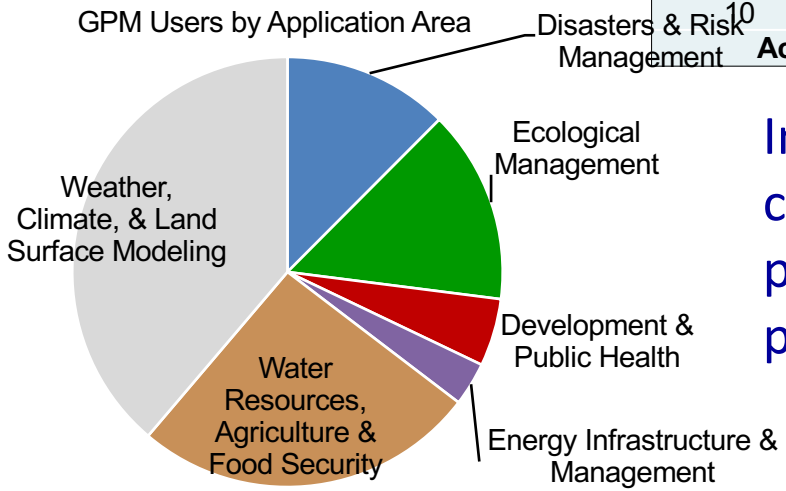


Goal is to better understand the user community and reach into sectors that may not be well represented or better engage active groups

Top 10 Countries by Number of Users for 2018

Ranking	Country	Users
1	United States	751
2	China	346
3	India	198
4	Brazil	127
5	Germany	89
6	Netherlands	88
7	United Kingdom	63
8	France	58
9	Australia	52
10	Italy	52

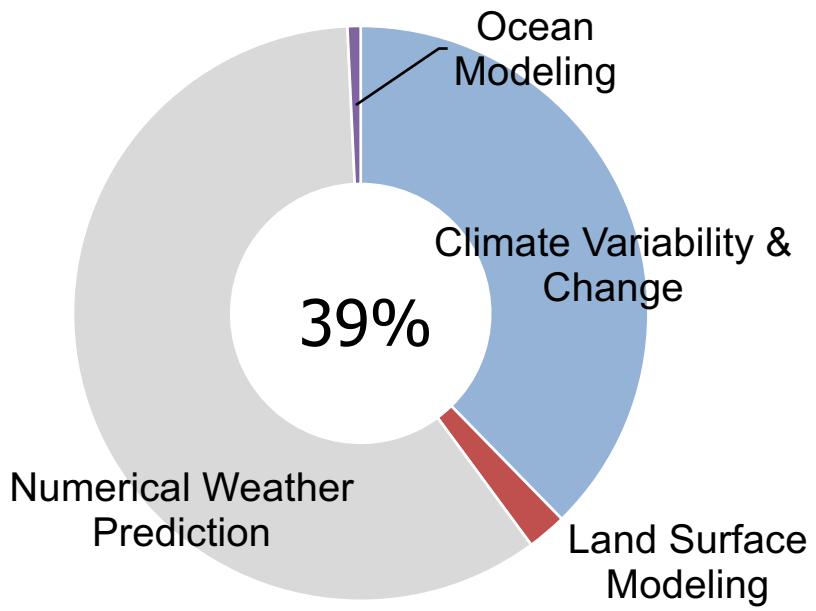
Accessed GPM data via the PPS



- 4,012 unique users obtained from PPS and other interactions
- E-mail, type of user, application area

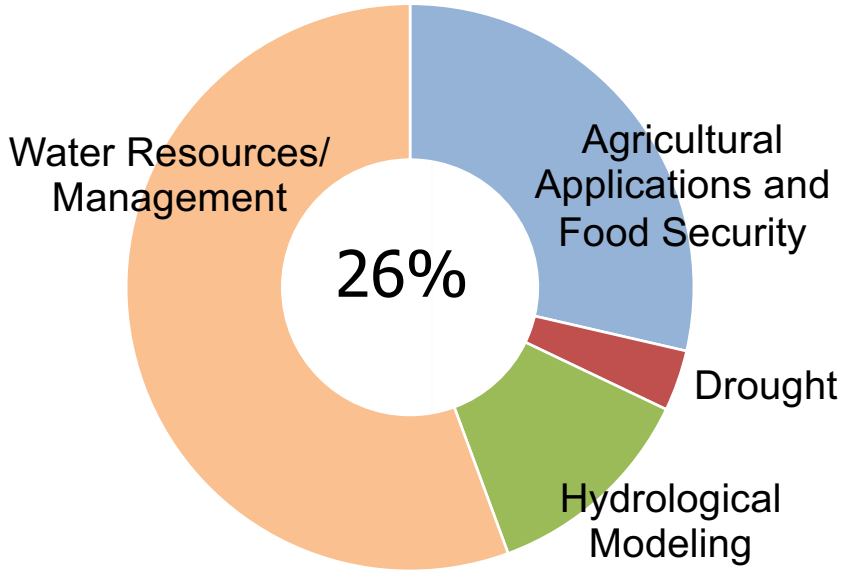
Interviews have been conducted with 25 people (e-mail and/or phone)

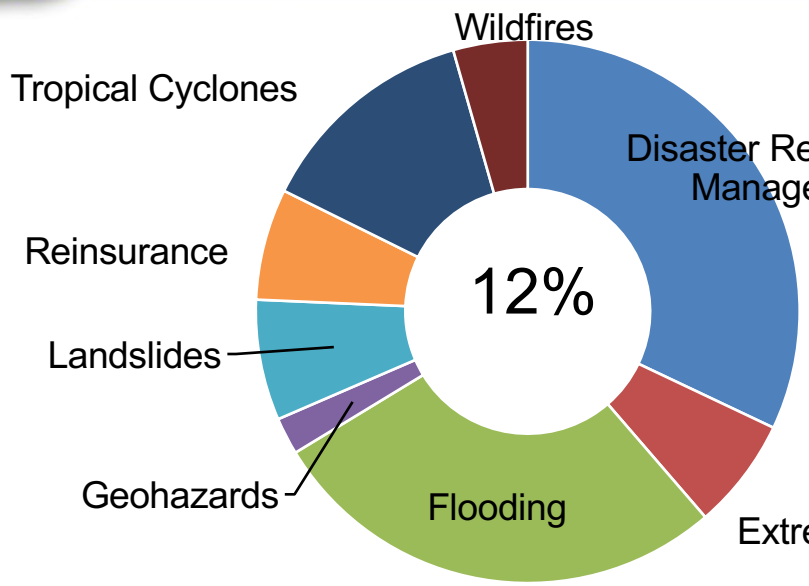
GLOBAL PRECIPITATION MEASUREMENT



Weather, Climate, Modeling

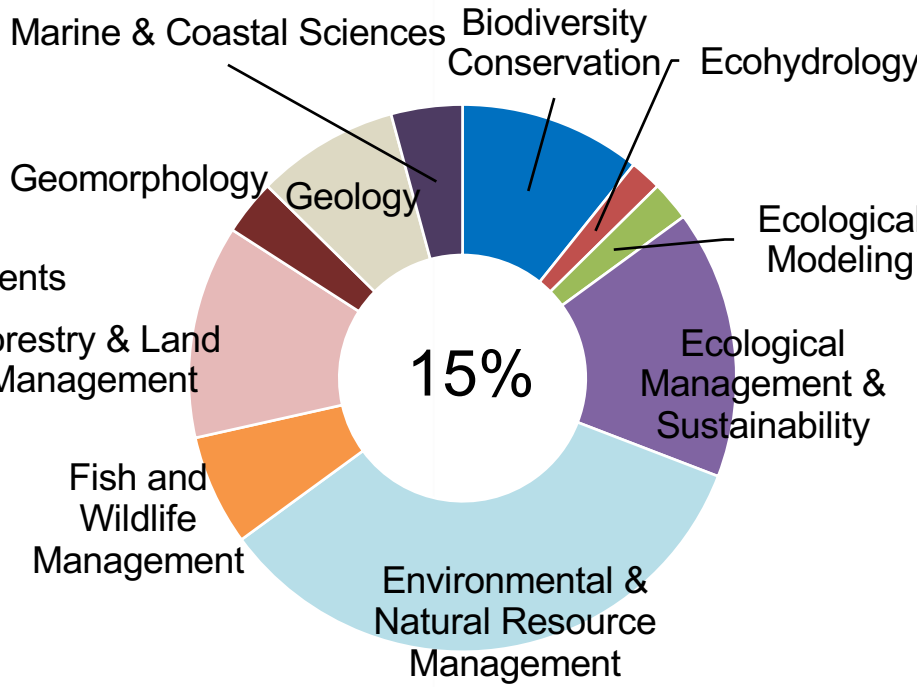
Water Resources, Agriculture, and Food Security





Disasters & Risk Management

Ecological Management



GLOBAL PRECIPITATION MEASUREMENT MISSION APPLICATIONS

Water Resources, Agricultural Forecasting & Food Security

Growing human population, increased demand for water and energy, and a changing climate have contributed to concerns of how freshwater resources and food supply and production may be stressed. Both water resource managers and the agricultural community need to know the amount, distribution, timing and onset of seasonal rainfall to prepare for freshwater shortages and forecast crop yields. Remotely sensed precipitation estimates play a key role in predicting changes in freshwater supply and agricultural forecasting. The Water Resources, Agricultural Forecasting and Food Security applications area highlights examples and encourages the use of GPM precipitation data to analyze and forecast changes that affect water resources and its subsequent impact on agricultural productivity.

Credit: USDA FAS

Have Ideas? Get Involved!
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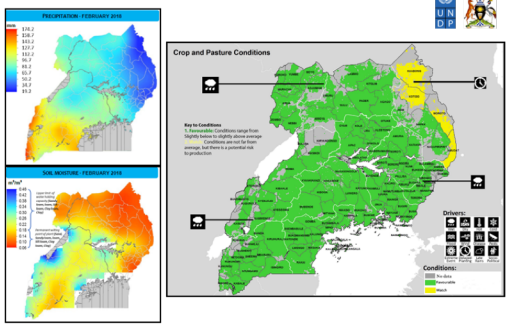
CASE STUDY: Monitoring Crop Conditions throughout Uganda



U-NIEWS, Vol. 2, Issue No. 17: Maps created with satellite precipitation data (top left) and soil moisture (bottom left) for February 2018. Crop and pasture conditions using satellite data as variables (right).

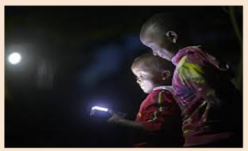
The National Emergency Coordination and Operations Centre (NECOC), with the support of United Nations Development Programme (UNDP), is Uganda's central facility for early warning and the coordination of emergency and crisis response and recovery action. NECOC provides publicly available monthly bulletins, U-NIEWS (Uganda National Integrated Multi Hazard Early Warning System), to understand crop and pasture conditions, food insecurity, weather/climate forecast and to determine anticipated disasters while providing disaster management and humanitarian aid information.

Each month, NASA rainfall data are combined with soil moisture, temperature, and evapotranspiration data to analyze crop and pasture conditions in Uganda at the national and sub-national level to determine crop production risks. This information enables NECOC and UNDP to determine the probability of food insecurity and other disasters such as flooding and landslides to issue warnings and alerts. The data is analyzed and shared among government departments, parliament ministers, diplomatic missions, academics, UN Agencies, NGOs, farmer organizations, and the public via emails.

GLOBAL PRECIPITATION MEASUREMENT MISSION APPLICATIONS

Energy Infrastructure and Management

In many areas, energy infrastructure assets, such as power plants and electric grids, can suffer damage or disruption in service due to a variety of climate-related impacts like extreme precipitation, high temperatures, drought, and rising sea levels. For example, warmer temperatures and little rainfall can cause changes in peak streamflow conditions that affect hydropower generation. Heavy precipitation events and flooding can impact a region's energy infrastructure, including electric grid equipment, which has cascading effects on freshwater supplies and emergency services. The Energy Infrastructure and Management applications area promotes the use of GPM satellite precipitation data for key decisions or analyses within the energy sector. This includes the use of climatology data in the prediction of energy demand, development, harvesting, and production of non/renewable energy resources, and load forecasting.



Credit: USAID

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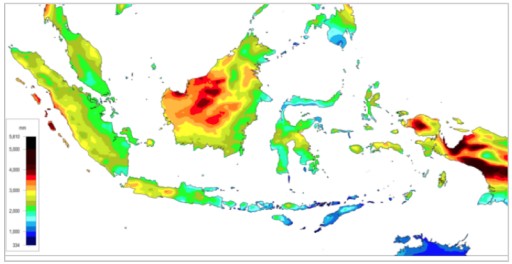
CASE STUDY: Driving Hydropower Generation in Indonesia



Average annual rainfall in Indonesia, 2014 – 2017, shown with GPM IMERG data (INDONESIA HYDRO™ CONSULT)

Availability of water flow is an important factor in the planning and development of a hydropower plant to estimate its potential capacity and energy production. To determine flow availability, hydrological modeling is carried out, which relies on multiple inputs including rainfall, discharge, ground slope, vegetation, and evapotranspiration. INDONESIA HYDRO™ CONSULT is using NASA's TRMM and GPM IMERG precipitation data as a variable in the development of hydropower plants throughout Indonesia and it surroundings where rivers are either ungauged or quality of records from the gauging stations are unreliable.

Kincang Hydropower Project in Indonesia was undertaken by INDONESIA HYDRO™ CONSULT to assess water flow for hydropower production.

Vector and Waterborne Disease Workshop

The Wilson Center | 1300 Pennsylvania Ave NW | Washington, DC 20004
May 17, 2018

NASA's Global Precipitation Measurement mission and The Wilson Center are excited to be co-sponsoring a day-long Vector and Waterborne Disease Workshop that brings together leaders in epidemiology, public health, policy, and citizen science. The goal is to advance the dialogue and collaborate on actionable techniques for utilizing Earth Observation data for theunderstanding, monitoring, and prediction of emerging diseases.

Keynote Speakers:

Rita Colwell Ph.D.

- Distinguished Professor at University of Maryland College Park and Johns Hopkins Bloomberg School of Public Health
- Director of National Science Foundation 1998-2004
- Recipient of National Medal for Science from George W. Bush 2006

Rep Bill Foster Ph.D.

- Congressman from Illinois' 11th District
- Received his Ph.D. in physics from Harvard University
- Sits on the House Committee on Financial Services and the House Committee on Science, Space, and Technology

Madeleine Thomson Ph.D.

- Director, WHO Collaborating Centre (US 306) on Early Warning Systems for Malaria and other Climate Sensitive Diseases
- Senior Research Scientist, International Research Institute for Climate and Society

Agenda Overview

9:00	Introduction
9:30	Keynote Speaker: Rep. Bill Foster Ph.D.
10:15	Panel on New and Emerging Research
11:25	Keynote Speaker: Rita Colwell Ph.D.
1:05	Panel on Health, Data, and Complexity
2:00	Panel on Citizen Science and Outreach
2:50	Breakout Sessions
4:05	Keynote Presentation: Madeleine Thomson Ph.D.
5:00	Cocktail Reception

Co-Chairs

Dorian Janney | NASA

Outreach Specialist, Global Precipitation Measurement Mission

Anne Bowser Ph.D. | The Wilson Center

Director, Innovation and Innovation Specialist in the Science and Technology Innovation Program

For more information on the workshop and registration please visit:

www.wilsoncenter.org/event/2018-vector-borne-and-water-related-disease-workshop

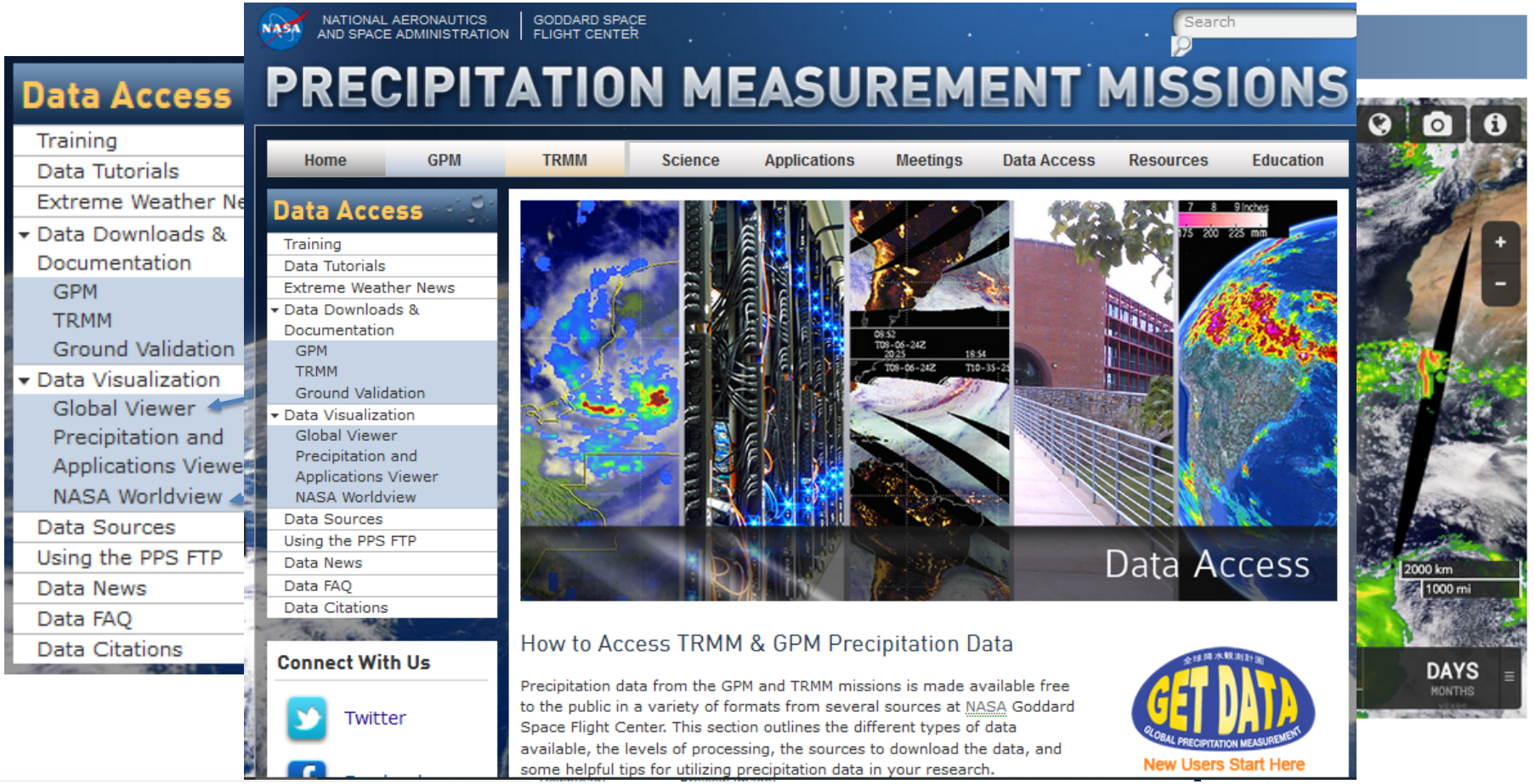
or

https://pmm.nasa.gov/disease-initiative

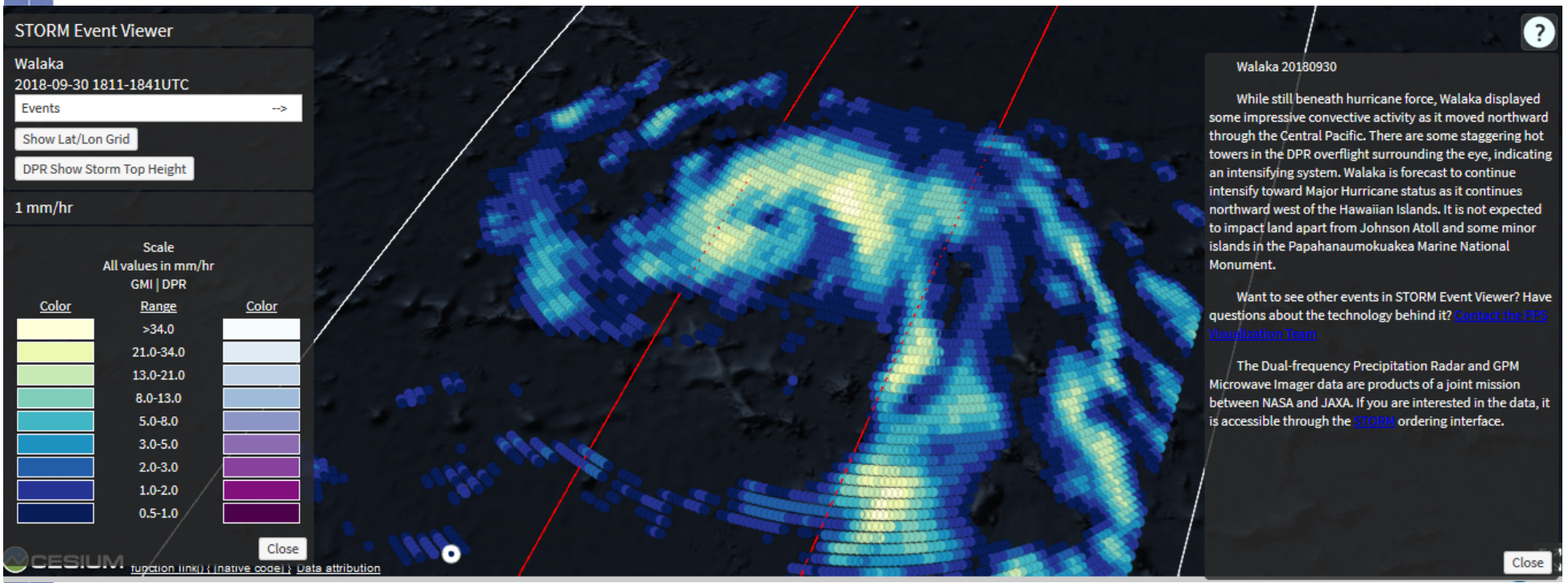
Registration closes on April 15th or when all available spots are allocated

New Data and Visualization Activities

https://pmm.nasa.gov/data-access

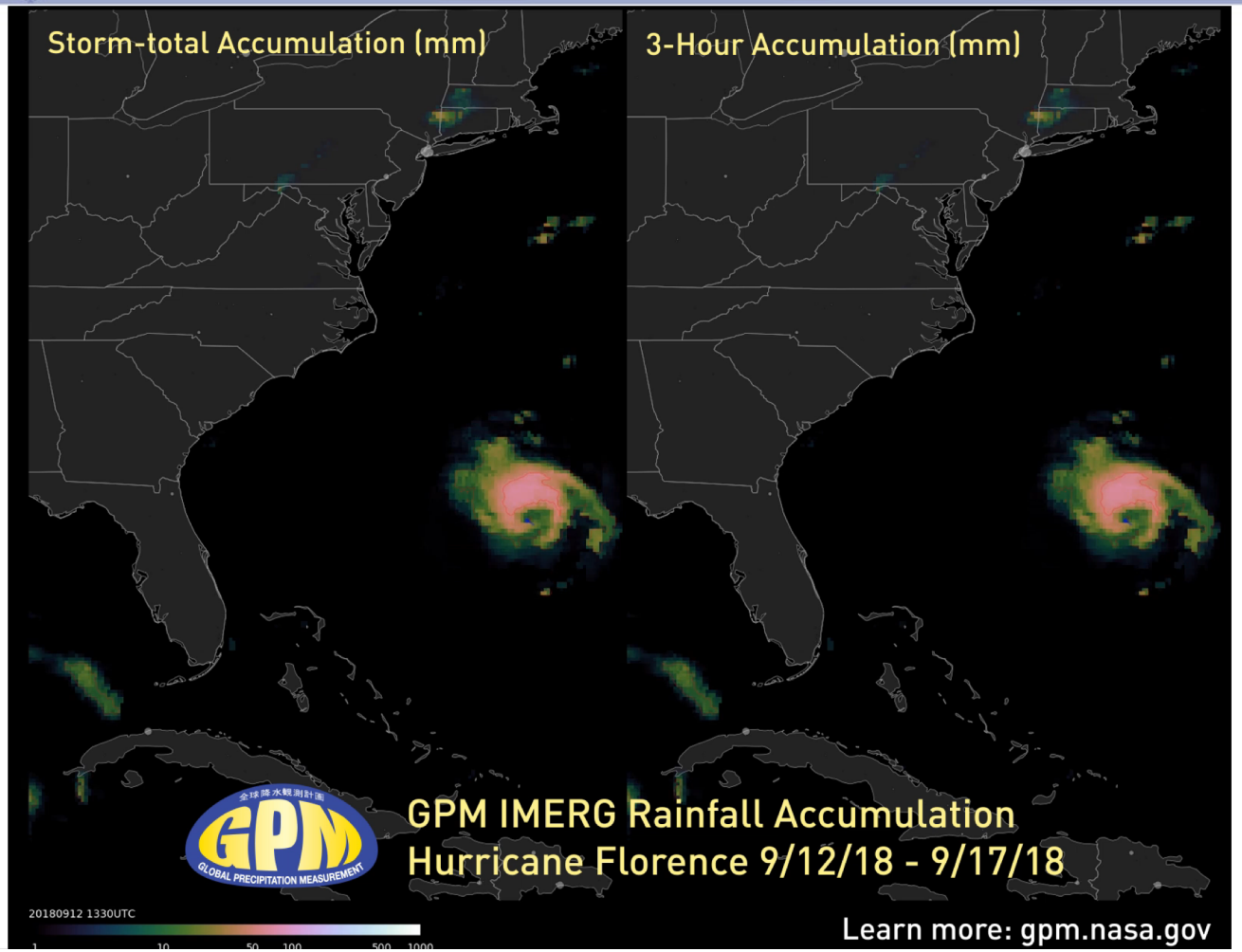


STORM Event Viewer



https://pmm.nasa.gov/data-access/visualization

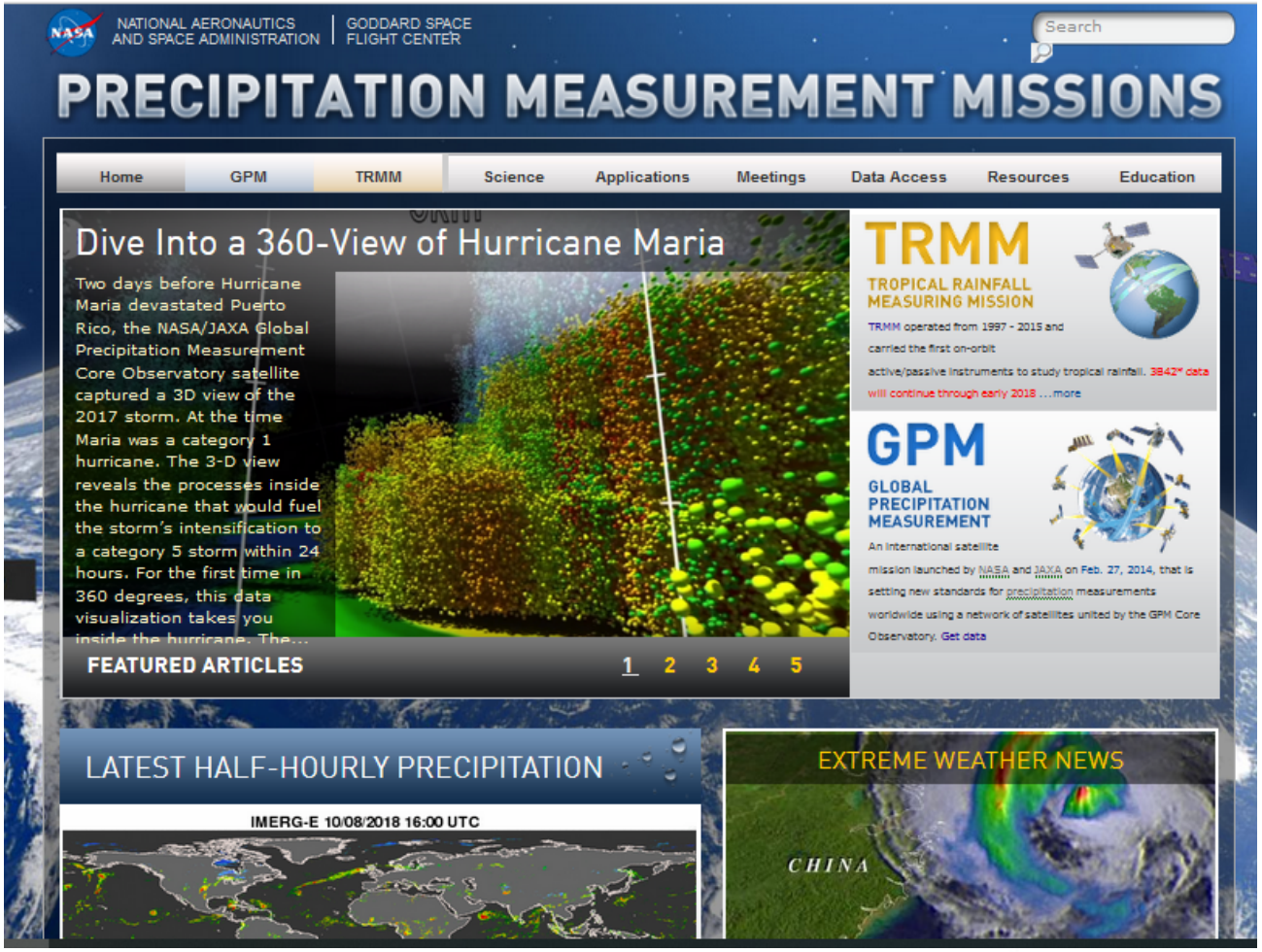
Hurricane Florence Rainfall Accumulation



GLOBAL PRECIPITATION MEASUREMENT

Outreach Activities

- **Applications Video Series:** Fires, Cholera, Malaria, Landslides
- **New Visualizations**: See Hurricane Maria in 360
- **Weekly Highlights**: Goes to management but will be posted each week on our website
- **Back to Class!:** New resources for visiting K-12 classrooms
- **New Website Redesign:** in progress
- **Social Media**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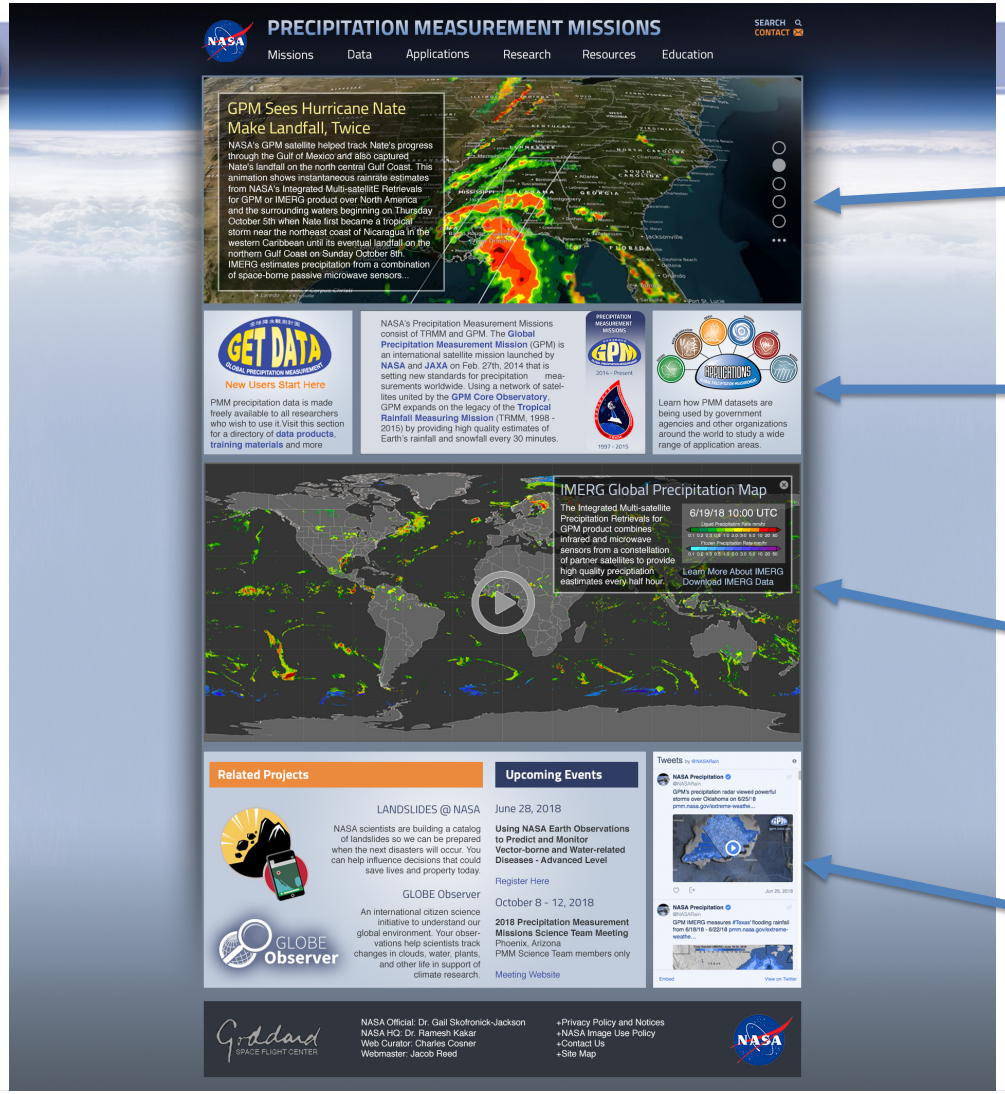
Dive Into a 360-View of Hurricane Maria
Two days before Hurricane Maria devastated Puerto Rico, the NASA/JAXA Global Precipitation Measurement Core Observatory satellite captured a 3D view of the 2017 storm. At the time Maria was a category 1 hurricane. The 3-D view reveals the processes inside the hurricane that would fuel the storm's intensification to a category 5 storm within 24 hours. For the first time in 360 degrees, this data visualization takes you
FEATURED ARTICLES
1 2 3 4 5
TRMM
TROPICAL RAINFALL MEASURING MISSION
TRMM operated from 1997 - 2015 and carried the first on-orbit active/passive instruments to study tropical rainfall. 3B42™ data will continue through early 2018 ...more
GPM
GLOBAL PRECIPITATION MEASUREMENT
An international satellite mission launched by NASA and JAXA on Feb. 27, 2014, that is setting new standards for precipitation measurements worldwide using a network of satellites united by the GPM Core Observatory. Get data
LATEST HALF-HOURLY PRECIPITATION
IMERG-E 10/08/2018 16:00 UTC
EXTREME WEATHER NEWS
CHINA

New Website Redesign



Rotating banner for stories

Data access, mission information and applications

Near real-time feed of IMERG as a looped 7-day map

Social media updates, upcoming events and featured resources

SVS Video Gallery

GLOBAL PRECIPITATION MEASUREMENT

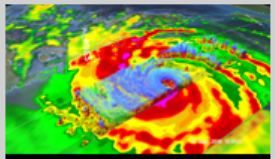
Scientific Visualization Studio

SEARCH GALLERIES HELP

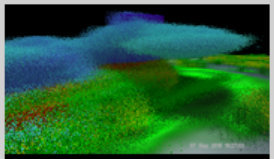
Content Contact: Ryan Fitzgibbons

- Featured
- Near Real-Time IMERG
- 2018 Hurricanes & Typhoons
- 2017 Hurricanes & Typhoons
- 2016 Hurricanes & Typhoons
- 2015 Hurricanes & Typhoons
- 2014 Hurricanes & Typhoons
- Snow
- Other Extreme Weather
- IMERG Visualizations
- GPM Applications
- Video Features
- Facebook Live Events
- Data Visualizations
- Animations
- People of GPM
- OLYMPEX Field Campaign 2015-2016
- Launch Coverage
- Countdown to Launch
- Raw Media for Broadcast
- Prelaunch Press Briefings

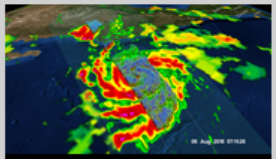
2018 Hurricanes & Typhoons



GPM Captures Super Typhoon Mangkhut Approaching The Philippines
2018.09.19

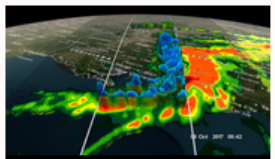


GOES and GPM Capture Florence Trying to Intensify Over the Atlantic
2018.09.12

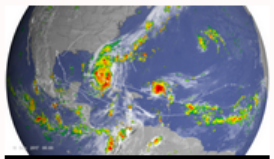


GPM passes directly over Tropical Storm John off the coast of Mexico
2018.08.06

2017 Hurricanes & Typhoons

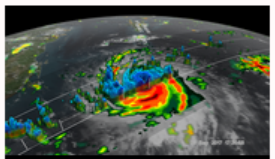


GPM Catches Hurricane Nate's Landfall...Twice
2017.10.10

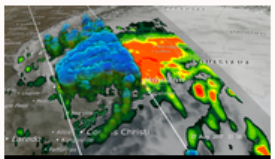


Hurricane Tracks from 2017 with Precipitation and Cloud Data
2017.10.05

Hurricane Jose lingers in the Atlantic as Hurricane Maria approaches Puerto Rico
2017.09.19

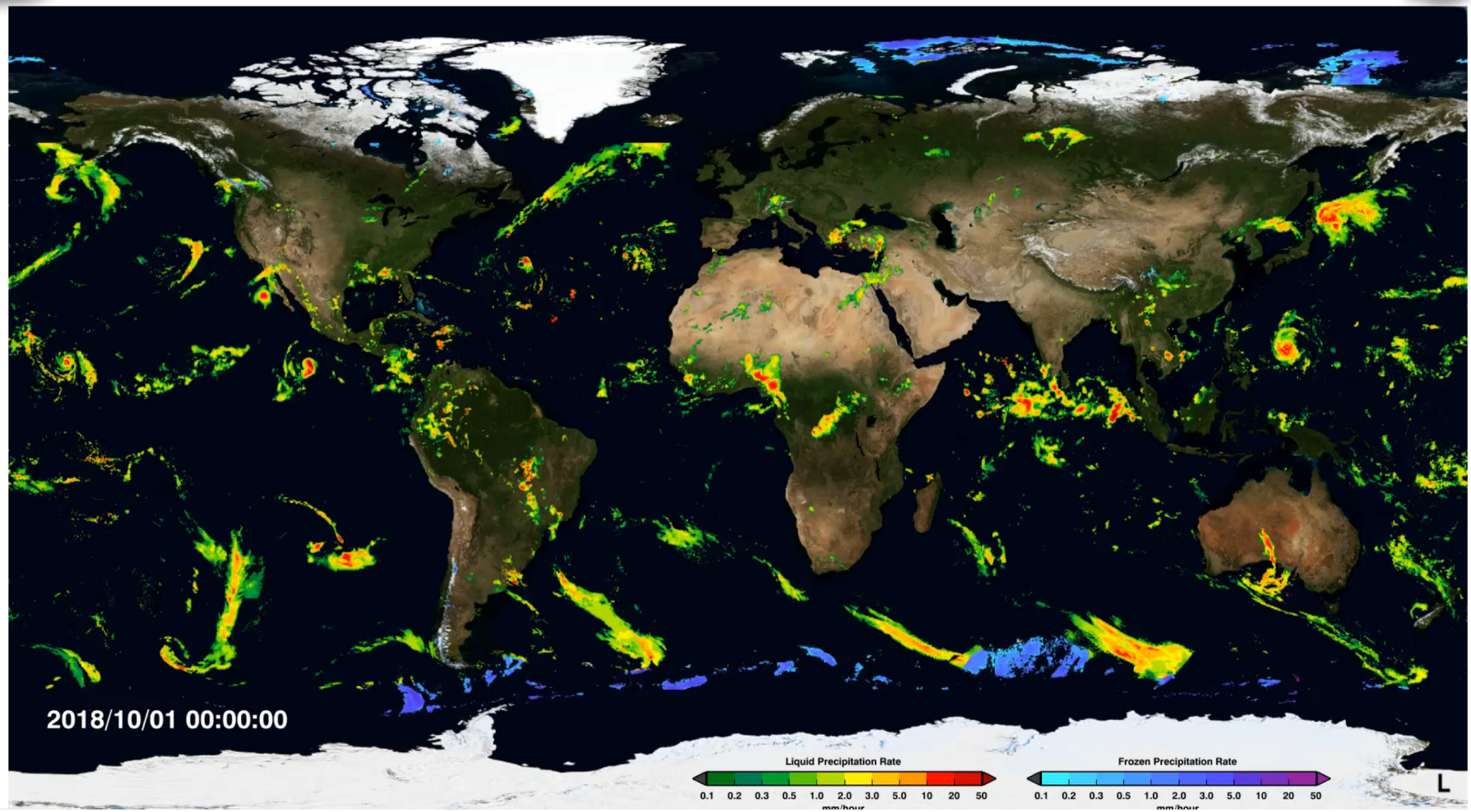


GPM Examines Hurricane Irma
2017.09.10



Hurricane Harvey
2017.08.31

Near real-time IMERG: 7-day loop



GLOBAL PRECIPITATION MEASUREMENT

Applications Video Series

GPM Applications

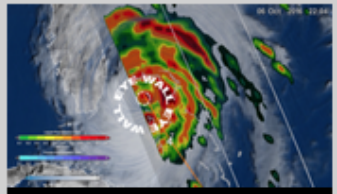
Videos focusing on the application of GPM data around the world.

NASA Rainfall Data and Global Fire Weather
2018.06.28

Using Precipitation Data to Assess Risk of Cholera Outbreaks
2018.05.18

New NASA Model Finds Landslide Threats in Near Real-Time During Heavy Rains
2018.03.22

Predicting Malaria Outbreaks With NASA Satellites
2017.09.13



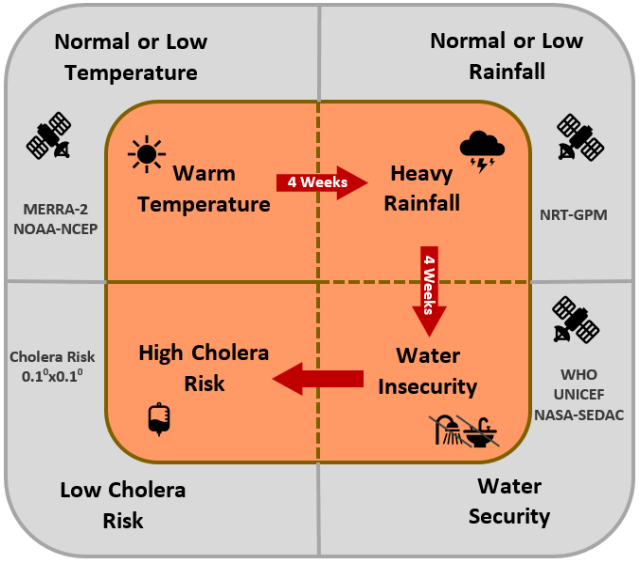
A New Multi-dimensional View of a Hurricane
2017.07.25

https://svs.gsfc.nasa.gov/Gallery/GPM.html

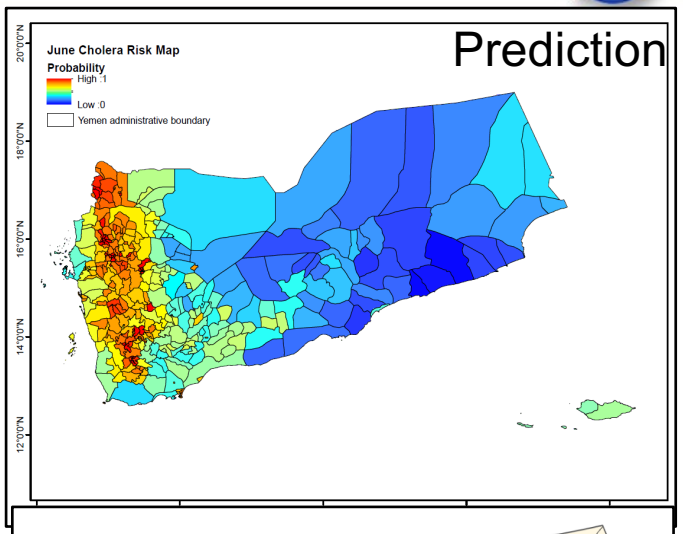
Predicting Cholera in Yemen using NASA Satellites

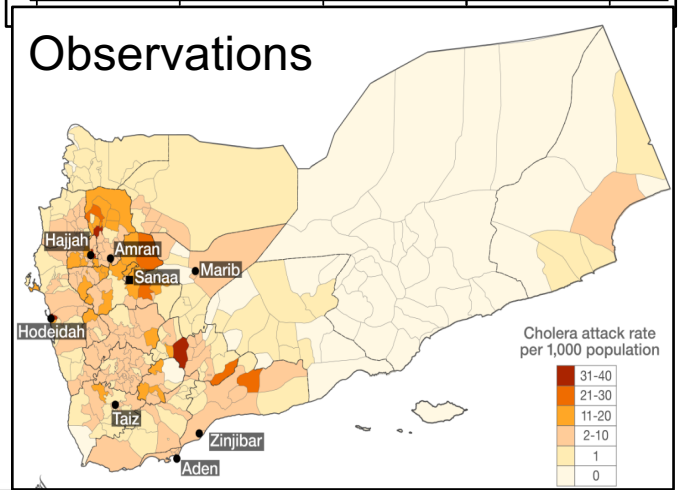
GLOBAL PRECIPITATION MEASUREMENT

Predicting favorable conditions for cholera outbreaks relies on identifying areas of above average temperatures and rainfall, poor water infrastructures and changes in land use. Scientists are monitoring regional hydroclimatic processes and changes in the aquatic ecosystem with NASA satellite data, including precipitation from TRMM and GPM, air temperatures from MODIS, and water storage information from GRACE to develop forecasts of the risk of a cholera outbreak across developing countries such as Yemen and Bangladesh. These data, along with other products, are used to assess the areas most at risk of cholera. Project findings are being used to map unsafe water sources, prepare warnings related to water quality, and predict the potential of disease outbreaks.



Flow chart to determine areas at high cholera risk using satellite data (top right). Real-time cholera risk prediction map for Yemen in June 2017 (top left). Areas in red have the highest risk of cholera outbreak. In-country records that a cholera epidemic occurred in June 2017 (right). Content and image credits: Antar Jutla, West Virginia University, & Rita Colwell, University of Maryland

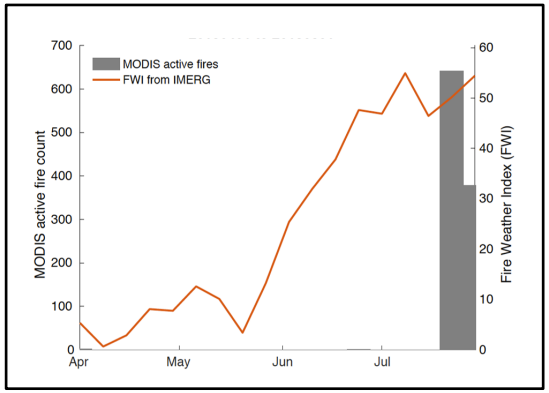




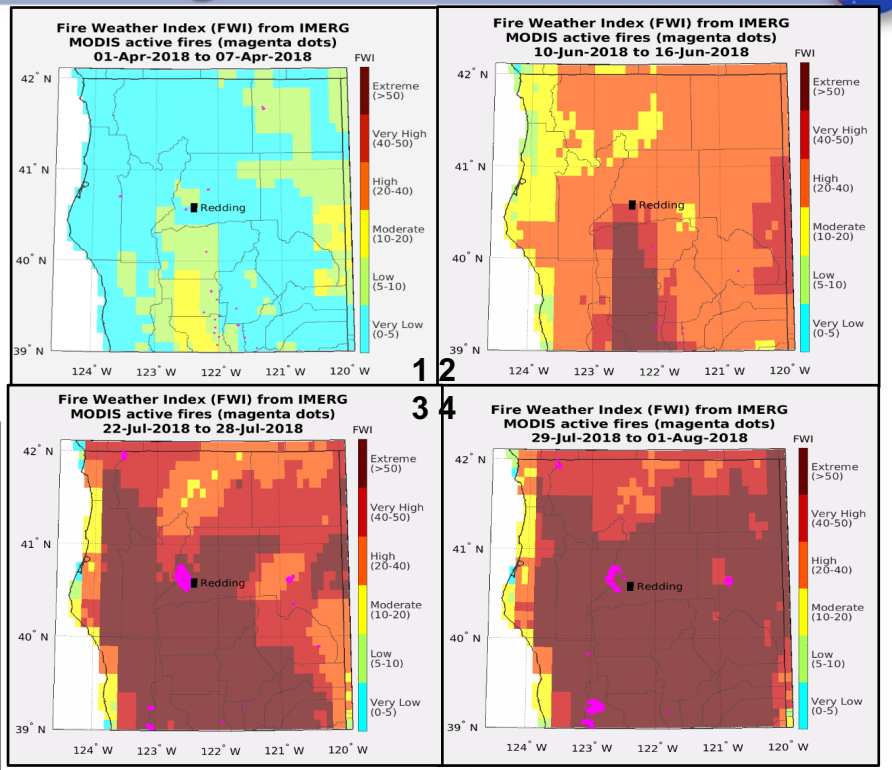
Monitoring California's Carr Fire

The Carr Fire in Northern California erupted on July 23, 2018 and covered over 195 miles (~127,000 acres) by August 2. Hot, dry and windy conditions combined with an extraordinarily high fuel load in the area have transformed the low, local burn into an expansive blaze. To help understand and monitor areas for fire danger such as the Carr Fire, NASA's Global Fire WEather Database (GFWED) is used which integrates different weather factors, including daily GPM IMERG precipitation estimates, influencing the likelihood of a vegetation fire starting and spreading.

GFWED provides a globally consistent fire weather dataset for fire researchers and managers to apply locally.
Data are available via the Global Fire Weather Database: https://data.giss.nasa.gov/impacts/gfwed/.



Weekly FWI and MODIS active fire totals over the Carr fire region from April through July, 2018.



Figures 1-4: Evolution of weekly FWI and MODIS active fires over northern California from April 1 to August 1, 2018. Low FWI in April, then FWI increased in June, and was consistently at Very High or Extreme levels through July. FWI is computed using local 12:00pm surface temperature, relative humidity and wind speed from NASA GMAO's GEOS-5 model, and daily IMERG precipitation estimates.

Image and caption credits: Robert Field, robert.field@columbia.edu

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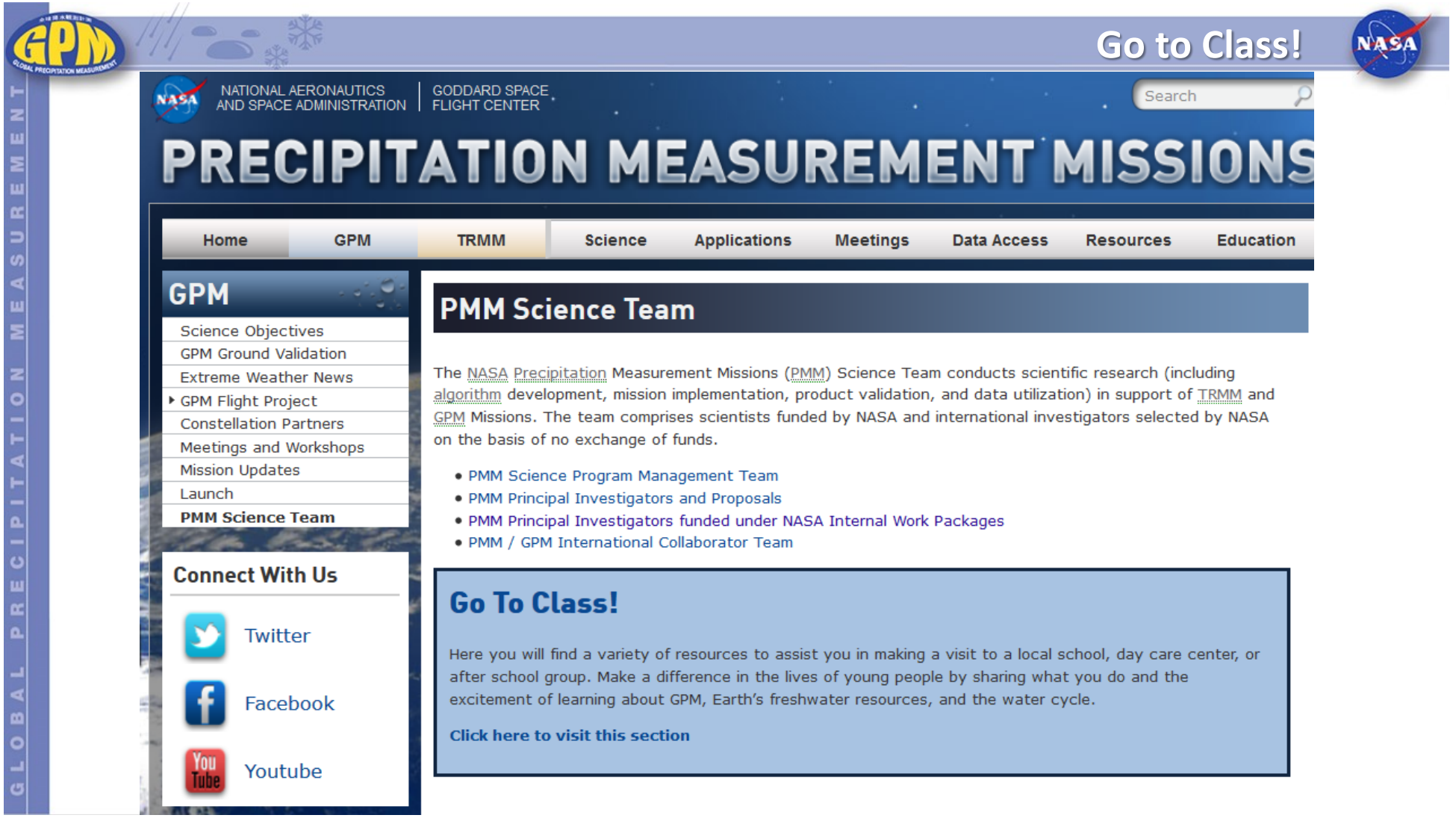
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Resources
Education
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Science Objectives
GPM Ground Validation
Extreme Weather News
GPM Flight Project
Constellation Partners
Meetings and Workshops
Mission Updates
Launch
PMM Science Team
Connect With Us
Twitter
Facebook
Youtube
PMM Science Team
The NASA Precipitation Measurement Missions (PMM) Science Team conducts scientific research (including algorithm development, mission implementation, product validation, and data utilization) in support of TRMM and GPM Missions. The team comprises scientists funded by NASA and international investigators selected by NASA on the basis of no exchange of funds.
PMM Science Program Management Team
PMM Principal Investigators and Proposals
PMM Principal Investigators funded under NASA Internal Work Packages
PMM / GPM International Collaborator Team
Go To Class!
Here you will find a variety of resources to assist you in making a visit to a local school, day care center, or after school group. Make a difference in the lives of young people by sharing what you do and the excitement of learning about GPM, Earth's freshwater resources, and the water cycle.
Click here to visit this section

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  - GPM
  - TRMM
  - Flight Project
  - Ground Validation
- Videos
  - GPM
  - TRMM
  - Ground Validation
- Featured Articles Archive
- Media & Press
- GPM Refereed Publications
- TRMM Refereed Publications
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- Acronyms
- 3D Printed GPM Preciptation Data
- **Go To Class**
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  - Elementary
  - High School
  - Middle School
  - Preschool

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- Contact Us

Go To Class

We Want You to Go to Class!

Our students desperately need to have some face to face time with scientists and engineers who are doing amazing things to make their world a better place. That means you guys! From time to time, you may be invited to give a presentation on your work to kids in some context- and we want to make it easier for you. You might even reach out yourself to your local school and offer to come in and give a talk.

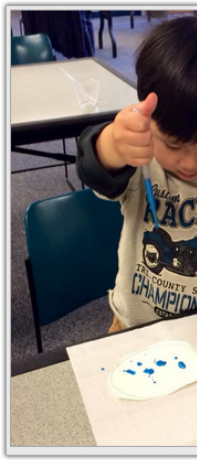
Having been a classroom teacher across all grade levels by the time I finished my illustrious career, I know personally the joy of having real STEM professionals come in and share the excitement and wonder of their work with my students. I also know that many of them felt a bit out of their comfort zone trying to explain what they did to the eager little 6-year-old faces looking up at them. Below you will find some hints, Best Practices, links to the National Science Standards, and sample activities to do with kids across all grade levels, from pre-K to high school!

Should you have any questions, feel free to reach out to me. I can also send you some GPM "droplets", anime comic books, and/or stickers to hand out while you are visiting the students. Contact me at dorian.w.janney@nasa.gov . Be sure to give me at least three weeks to mail things out.

Click on the age/grade levels below to see ideas for how you can "Go to Class" and make lasting memories as you inspire kids and their teachers!

- Preschool (ages 2 through 5 years)
- Early Childhood (grades K through 2nd)
- Elementary School (grades 3rd-5th)
- Middle School (grades 6-8)
- High School (grades 9-12)

Preschool



These are such fun little people lots of enthusiasm and questio everything they know and then turn to share in. While that is e you are trying to convey pretty

Here are some general guidelines

- **A typical presentation to t like this:**
  - Everyone is sitting on t sitting on a small chair on carpet squares or in
  - You introduce yourself, you if they know you a introduction your name hydrologist; and what
  - A very short introductio about clouds and how t a little bit about how ra When I am finished, w learn a little more".
  - You talk for a few minu everyone can respond out the answer togethe about their weekend a sidetracked if you allov questions by individual
  - Have a few slides to sh I will list a few suggest age level. When you sl the slide pointing thing call out the names of t have them repeat som the water cycle (only th evaporation- condensa

Early Childhood

Students in K-2nd grades are eage scientist come to visit their class often like to share their experienc look over the suggestions in the Best Practices for giving presentat

There are many ways in which the meaningful and engaging to child some of the Next Generation Scie states across the country) that rel might present on to children in th attempting to teach everything in information in the standard will gi children in that grade level need t their knowledge. You are just one achieve these rather broad and co

Kindergarten:

- K-ESS2 Earth's Systems
- K-ESS3 Earth and Human Acti

First Grade:

- 1-LS1 From Molecules to Orga

Second Grade:

- 2-ESS2-1 Earth's Systems
- 2- LS2 Ecosystems: Interactio

The key topic areas that are relev these grade levels center around availability/resources. You can fin videos we have developed and ga topics below. You might look over could also forward the lists to the resources.

High School

Students in high school are very interested in hearing about science from "real" scientists! Although they have a lot of background knowledge about natural phenomena, they will also have misconceptions as well. They are also at the age in which they will begin to consider their future career interests, and hearing from you about why you chose your career will be very interesting to them. They may be reticent at first to answer questions for fear of "sticking out" among their peers. Take a few minutes to read over the "Giving Presentations in Secondary Schools" get a feel for what secondary school classes are like and some pointers for presenting to students in these grade levels.

There are many ways in which the science behind the GPM mission is meaningful and engaging to students in high school classes. Here are some of the Next Generation Science Standards (followed by most states across the country) that relate directly themes germane to GPM's science and technology. Note that you aren't attempting to teach everything in the standards below- rather the information in the standard will give you a sense of what ultimately children in that grade level need to know and do to demonstrate their knowledge. You are just one small step toward helping them achieve these rather broad and complicated standards of science.

- HS- ESS2 Earth's Systems
- HS- ESS3 Earth and Human Activity
- HS- PS4 Waves and their Applications in Technologies for Information Transfer
- HS- ETS1 Engineering Design

The key topic areas that are relevant to GPM and are related to students in these grade levels center around the water cycle and freshwater availability/resources. You can find many of the lessons plans and videos we have developed and gathered related to each of these topics below. You might look over these to get some ideas, and could also forward the lists to the teacher to offer them additional resources.

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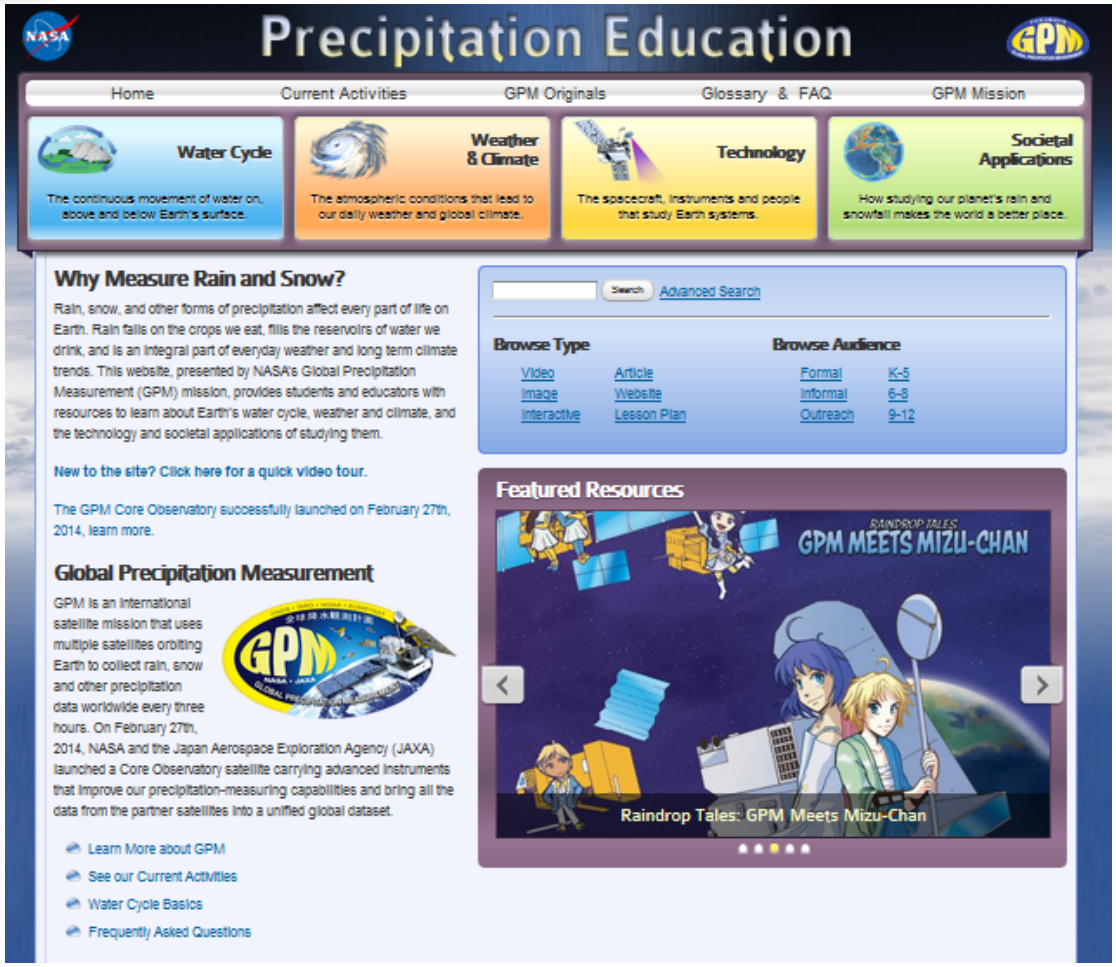
Go to a Grade

- Preschool
- Early Childhood
- Elementary School
- Middle School
- High School

Precipitation Education Webpage



https://pmm.nasa.gov/education/

183,854 pageviews per month

(PMM Website: 70,033 pageviews per month)

GPM Social Media Accounts

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Twitter: NASARain

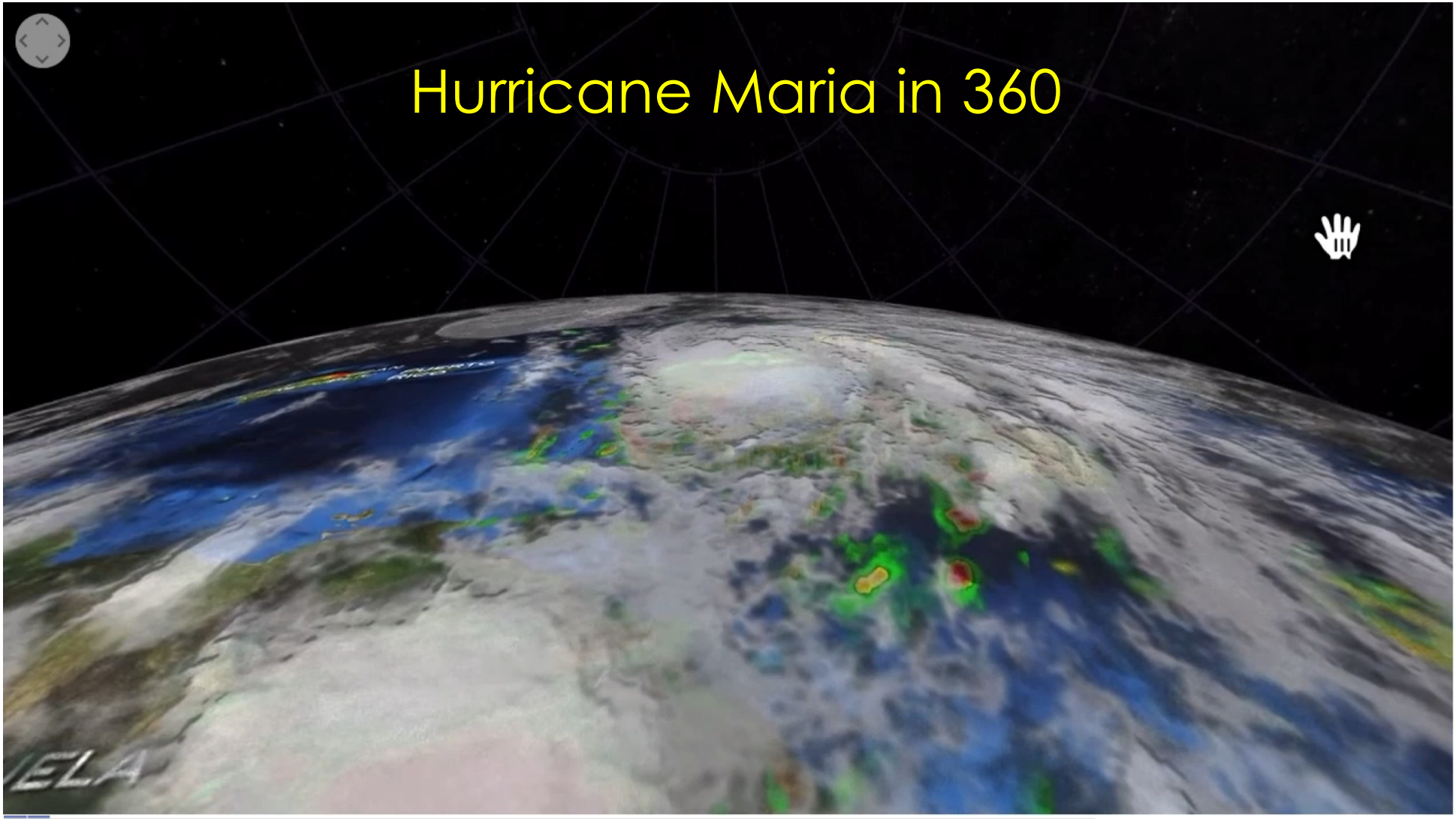
25,100+ followers

https://www.twitter.com/NASA_Rain

Facebook: NASARain

52,600+ Followers

https://www.facebook.com/NASA.Rain


Hurricane Maria in 360

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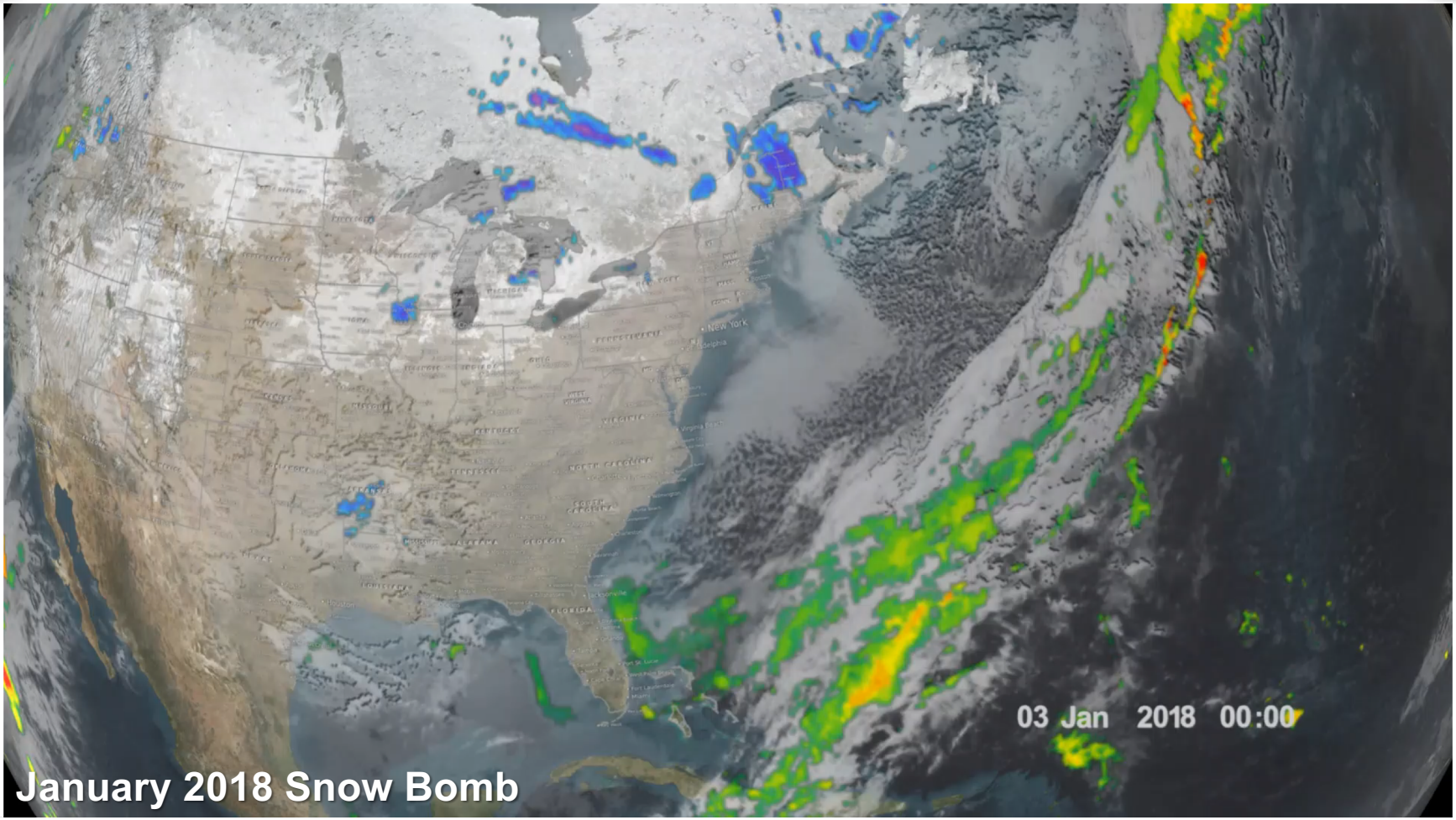
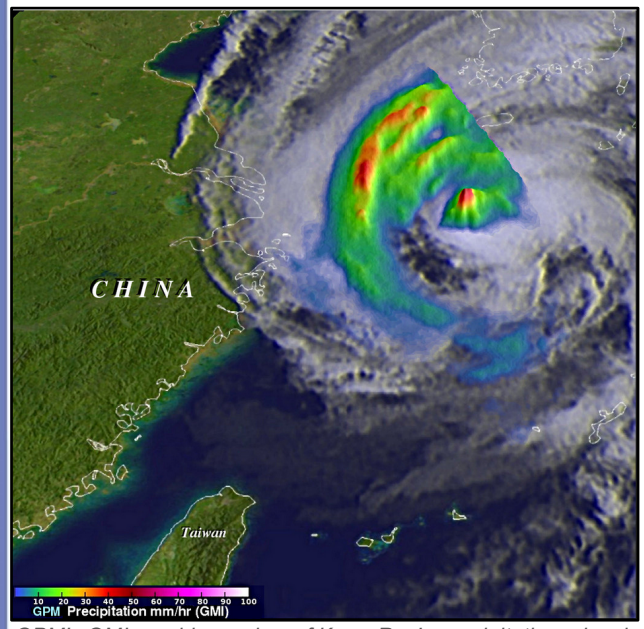
SVS Gallery Page: https://svs.gsfc.nasa.gov/Gallery/GPM.html



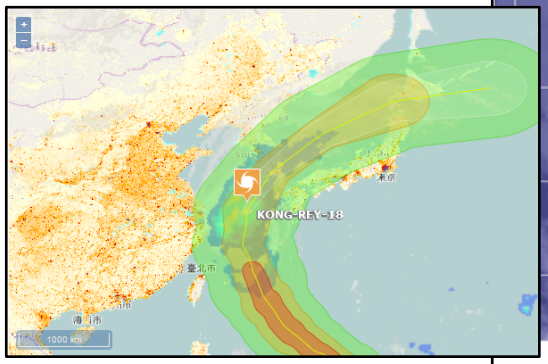
January 2018 Snow Bomb

GPM used to Communicate Kong-Rey's Intensity

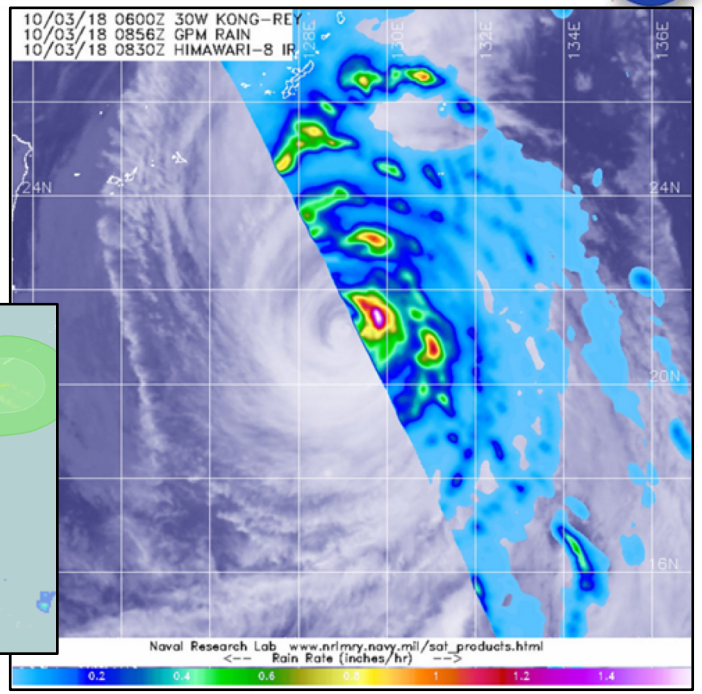
The GPM Core Observatory (CO) passed over tropical storm Kong-Rey in the northwestern Pacific Ocean on October 3 and 5, 2018 as it downgraded from a Category 5 typhoon to a tropical storm. Data collected by the GPM's Microwave Imager (GMI) were used to gauge the intensity of precipitation around Kong-Rey's center of circulation. Those measurements indicated the rain was still falling at a rate greater than 2.7 inches (68 mm) per hour in strong convective storms north of Kong-Rey's center of circulation.



GPM's GMI provides a view of Kong-Rey's precipitation, showing intense storms north of center on 10/05/2018. Credit: Hal Pierce (SSAI/NASA GSFC).



GDAC using IMERG data (blue shades) as an overlay to communicate the intensity and rainfall accumulation from Kong-Rey on 10/05/18.



Naval research Lab using GPM data as an overlay to the Himawari-8 satellite infrared imagery on 10/03/18 to assess Kong-Rey.

The Joint Typhoon Warning Center (JTWC) predicts that Kong-Rey will gradually weaken as it moves quickly toward the northeast over the southern tip of South Korea and parts of the Hokkaido Island. The US Navy's JWTC and Research Lab along with the Pacific Disaster Center (PDC), and the Global Disaster Alert and Coordination System (GDAC) are a few of many organizations that use GPM's data (including GMI, DPR and IMERG) to inform the public about storm development, location, and intensity.

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